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Engineering Institute Lecture Series

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Some Dynamics of the Electrical Grid

Tuesday, January 22, 2013

3:30 - 4:30 PM

Los Alamos Research Park, 2nd Floor, Conference Room 203A

Abstract: Today's electrical power grids are the largest engineered systems ever built. They are expected to reliably deliver power whenever and wherever the customer demands. In recent years, these seemingly mundane collections of wires and generators have become the focus of heated societal and technical discussions as the electrical grids of tomorrow are designed and debated. Topics range from large-scale blackouts to integration of renewable energy to the utility of smart appliances. The controversy is understandable because these systems affect almost every aspect of our day-to-day life. Many of these coming changes will affect the grid's electro-mechanical dynamics, i.e., the low-frequency oscillations of the rotational speed of the large-scale centralized generators that perturb the ideal 60-Hz grid frequency. Control of these dynamics is crucial to the reliability of the grid because dynamical perturbations that grow too large may result in local or even global electrical grid failure with possible damage to expensive generators. This talk will briefly review the fundamentals of electrical grid dynamics and then describe two emerging topics. The first is the use of ambient grid noise to extract the point-to-point linear dynamical response of transmission grids. Such techniques will prove useful in the future because they have the potential to provide transmission grid dynamical responses in near real time without requiring direct time integration of complex dynamical models or suffering from inaccuracies in these models. The second topic is the increasing nonlinearity of distribution grid dynamics caused by increased use of individually-hysteretic induction motors. These dynamics are creating new dynamical channels to voltage collapse—a dangerous phenomenon that previously only arose from static loading.

Biography: Scott Backhaus received his Ph.D. in Physics in 1997 from the University of California at Berkeley in the area of macroscopic quantum behavior of superfluid 3He and 4He. He came to Los Alamos in 1998 as a Director's Funded Postdoc from 1998 to 2000, a Reines Postdoctoral Fellow from 2001 to 2003, and a Technical Staff Member from 2003 to the present. While at Los Alamos, Backhaus has performed both experimental and theoretical research in the area of thermoacoustic energy conversion including fundamental topics such as several thermoacoustic streaming instabilities, streaming assisted heat transfer, and acoustic power manipulation. He holds seven patents in the area of thermoacoustics, and his work has been recognized with several awards including an R&D 100 award in 1999, a Technology Review's "Top 100 Innovators Under 35" award in 2003, and a "Best Paper of the Year" award in 2011 from the journal Cyrogenics. Recently, his attention has shifted to other energy-related topics including the fundamental science of grid-integration of renewable generation, geologic carbon sequestration, and thermal fluids problems related to energy and climate.

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